

TAXONOMY OF THE LARVAE, PUPAE AND FEMALES OF THE VICTORIAN SPECIES OF *CHIMARRA* STEPHENS (TRICHOPTERA: PHILOPOTAMIDAE) WITH NOTES ON BIOLOGY AND DISTRIBUTION

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The two species of *Chimarra* Stephens known from Victoria conform in most features with congeners described from overseas. Keys are provided for identification of adult males and females, pupae and larvae of the Victorian species, and information on the distribution of both species in Victoria as well as distribution records for the Yarra River system are presented. Details of the life history of *Chimarra australica* are included, as well as information on mesh size of the capture nets for both species.

THE GENUS *Chimarra* Stephens is represented in all faunal regions of the world and contains a large number of species, most of which are tropical or warm-temperate in distribution (Wiggins 1977). Four species have been recorded from Australia; descriptions of the males of three of these and the female of the fourth were given by Mosely & Kimmins (1953). In reference to *C. australis* Navás, described from the female, Kimmins stated that he was "unable to recognize this species from the description" (Mosely & Kimmins 1953: 404); the whereabouts of the holotype are unknown (Neboiss 1988).

Chimarra is apparently diverse in northern Australia, with numerous undescribed species in collections, but *C. australica* (Ulmer) and *C. monticola* Kimmins are the only species known to occur in Victoria (Neboiss, pers. comm.). Males and females of both of these species have been bred out, and the larvae and pupae are described below. Larvae of overseas *Chimarra* have been described by various authors including Barnard (1934), Ross (1944), Marlier (1964), Hickin (1967), Lepneva (1970) and Wiggins (1977), although both Hickin and Lepneva based their descriptions on an earlier account by Marlier (1943). Barnard (1934), Ross (1944) and Lepneva (1970) also described pupae of *Chimarra*. Few female *Chimarra* have been described (Ross 1944, 1948, Kimmins 1957, Schmid 1982). Published information on immature specimens of Australian *Chimarra* is restricted to a key to Victorian genera of Philopotamidae (Cartwright & Dean 1982), general comments on the family by Riek (1970), a de-

scription of the larva of an unidentified species of *Chimarra* from New South Wales (incorrectly associated and identified as *Hydrobiosella letti* Korboot) by Korboot (1964), an investigation of the life cycle of *C. monticola* (Dean & Cartwright 1987), and an examination of the digestive tract contents of an unnamed species of *Chimarra* from Victoria (Chessman 1986).

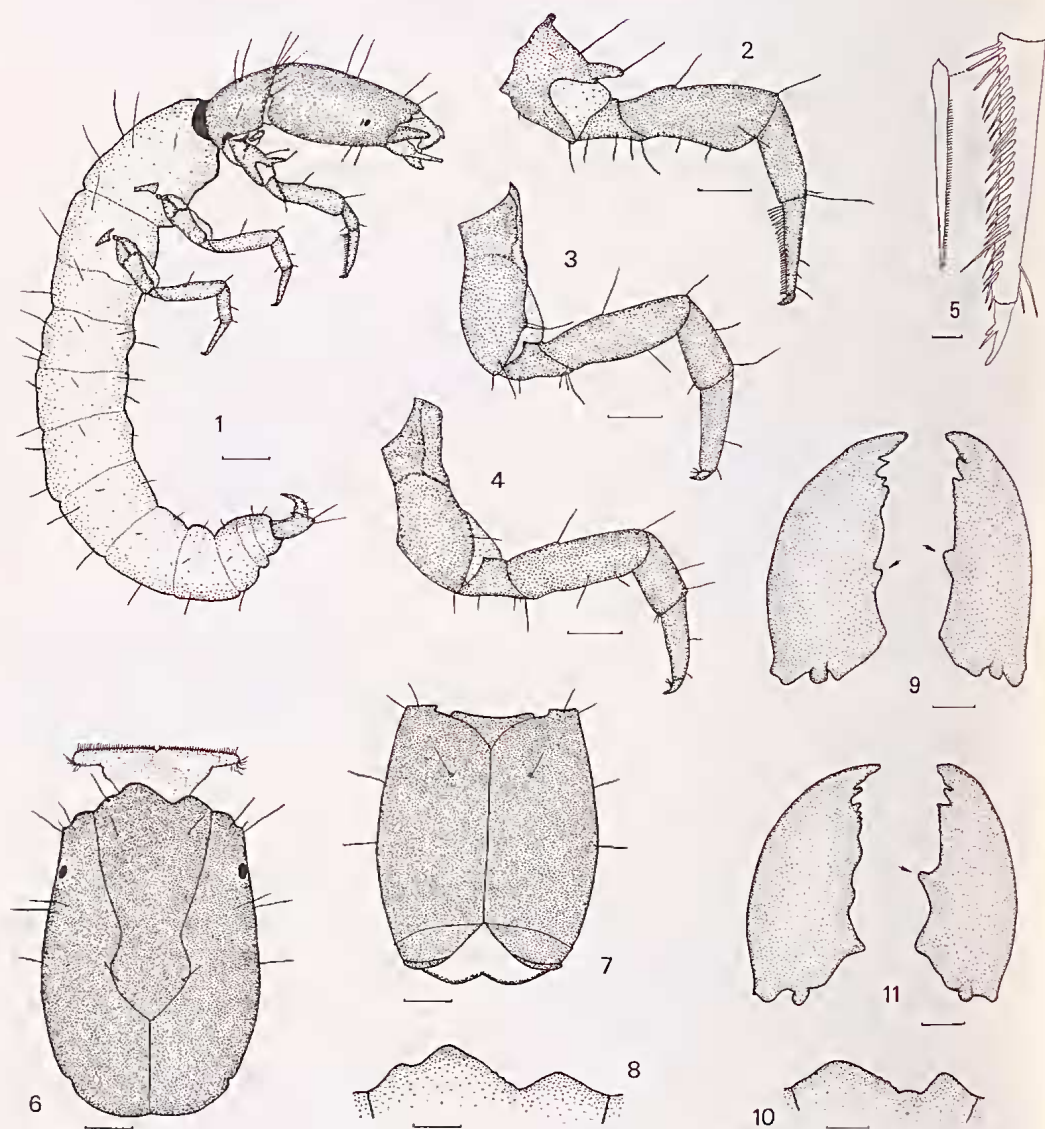
METHODS

Information on the distribution of *Chimarra* species in Victoria has been derived from extensive collecting of larvae over many years, supplemented by locality records of adult specimens held in the collections of the Museum of Victoria, Melbourne.

The life history of *Chimarra australica* was studied at a site on the Yarra River at Peninsula Road, approximately 80 km east of Melbourne and about 8 km downstream from the Upper Yarra Dam. The river at the study site is a fifth order stream but with reduced flow due to water abstraction upstream. Between August 1978 and February 1980, 12 samples were taken from a variety of habitats by a kick-sampling technique using a rectangular hand net (350 mm wide, mesh aperture size of 500 µm). Water temperature was measured at the time of sampling and ranged from 7.4°C (August) to 16.7°C (March). Stream discharge was measured at a site 1.5 km downstream of the sampling site. Total flow for the period January to September inclusive was 26,000 ML in 1978 and 8,000 ML in 1979 (MMBW Hydrographic Section records).

Larvae for life history determinations were examined under a stereomicroscope at $\times 50$ magnification; headwidth (to the nearest 0.02 mm) was measured. Larvae and pupae were collected by hand in order to rear adults for identification and to obtain information on the larval

capture net. Capture net dimensions were measured using a compound microscope at $\times 1000$ magnification. Female genitalia were drawn from cleared specimens, macerated in 10% KOH and transferred to glycerol for drawing.



Figs 1-11. Larvae of *Chimarra* Stevens. 1-9, *Chimarra monticola* Kimmins. 1, whole animal, scale = 0.5 mm. 2, foreleg, scale = 0.2 mm. 3, midleg, scale = 0.2 mm. 4, hindleg, scale = 0.2 mm. 5, tarsus of foreleg, detail of ventral seta, scale = 0.05 mm. 6, head including labrum, dorsal view, scale = 0.2 mm. 7, head, ventral view, scale = 0.2 mm. 8, anterior margin of frontoclypeal apotome, dorsal view, scale = 0.1 mm. 9, mandibles, ventral view, scale = 0.1 mm. 10-11, *Chimarra australica* (Ulmer). 10, anterior margin of frontoclypeal apotome, dorsal view, scale = 0.1 mm. 11, mandibles, ventral view, scale = 0.1 mm.

TAXONOMY

Chimarra Stephens

Figs 1–18

Final instar larva (Figs 1–11)

Diagnosis. (Modified after Ross 1944: 48–51, Lepneva 1970: 421–422, Wiggins 1977: 312–313.) Length 8–12 mm ($\bar{x}$ = 9.7 mm, n = 24). Larvae campodeiform. Head and pronotum sclerotized, orange-brown in colour. Mesonotum and metanotum not sclerotized. Abdomen white or yellow, abdominal gills absent (Fig. 1). Labrum membranous, brushlike, anterior margin broader than posterior margin. Frontoclypeal apotome narrow, constricted in posterior half. Anterior margin of frontoclypeal apotome with prominent asymmetrical notch (Figs 6, 8, 10). Ventral surface of head with seta number 18 located on anterior third of head capsule, transverse sulcus or ridge adjacent to occipital margin (Fig. 7). Thoracic legs simple, tarsus approximately same length as tibia, tarsal claw short and stout (Figs 2, 3, 4). Tarsus of foreleg with ventral row of setae, each seta with fringe of spinules on

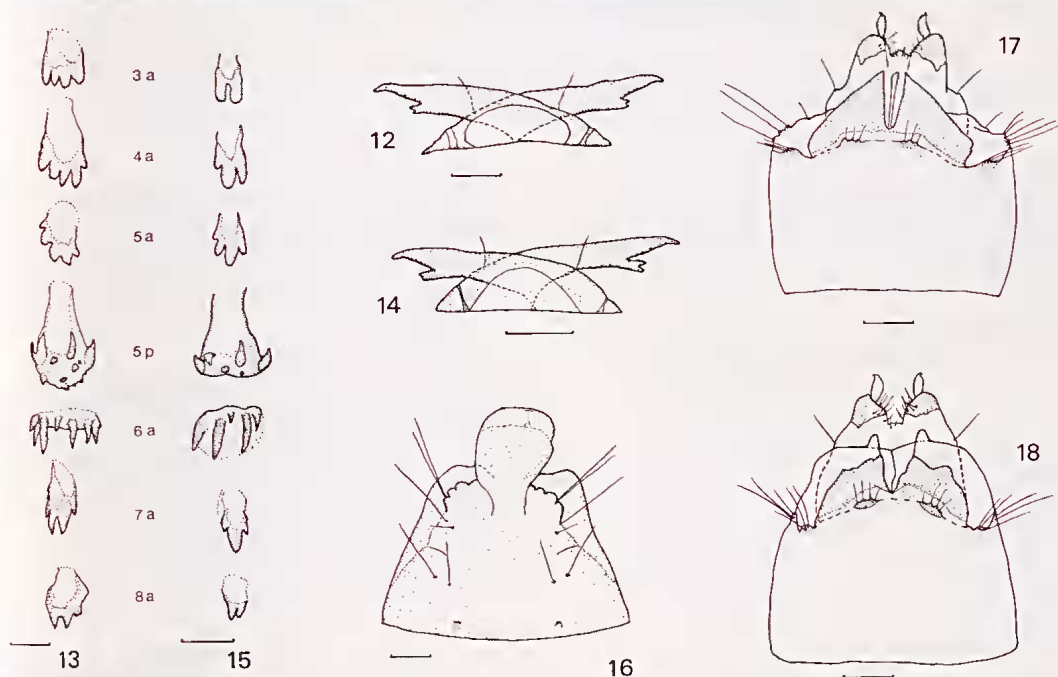
anterior margin. Spinules about 1 μ m apart (Fig. 5). Dorsal surface of forecoxa with a seta mesially, sclerotized process bearing a terminal seta distally (Fig. 2).

Pupa (Figs 12–16)

Diagnosis. (Modified after Lepneva 1970: 421–422.) Length 5.6–8.2 mm ($\bar{x}$ = 6.7 mm, n = 5). Labrum broadly rounded. Mandibles dark reddish-brown, curved near base, apices pointed with prominent bifid subapical tooth-like process (Figs 12, 14). Tibial spurs 1:4:4. Anterior hook plates present on abdominal segments 3–8, posterior hook plates present on segment 5 only (Figs 13, 15). Abdomen without gills or lateral fringe of setae. Apex of abdomen without paired anal processes (Fig. 16).

Female (Figs 17, 18)

Diagnosis. (Modified after Mosely & Kimmins 1953, Kimmins 1957, Schmid 1982.) Ocelli present. Maxillary palpi five-segmented, segment 5 long and flexible. Spurs 1:4:4. Anterior wings with R1 simple, apical forks 1, 2, 3 and 5 present;



Figs 12–18. Pupae and females of *Chimarra* Stephens. 12, 13, *Chimarra monticola* Kimmins pupa. 12, mandibles and labrum, dorsal view, scale = 0.2 mm. 13, hook plates, dorsal view, scale = 0.05 mm. 14–16, *Chimarra australica* (Ulmer) pupa. 14, mandibles and labrum, dorsal view, scale = 0.2 mm. 15, hook plates, dorsal view, scale = 0.05 mm. 16, tip of abdomen, dorsal view, scale = 0.1 mm. 17, *Chimarra monticola* Kimmins, female genitalia, ventral view, scale = 0.1 mm. 18, *Chimarra australica* (Ulmer), female genitalia, ventral view, scale = 0.1 mm.

Key to Victorian species of *Chimarra* Stephens

Larvae

1. Frontoclypeal notch V-shaped (Fig. 8, ∇); projection on inner margin of basal half of both mandibles (Fig. 9, ∇) *C. monticola* Kimmins
 — Frontoclypeal notch with flattened base (Fig. 10, ∇); projection on inner margin of basal half of left mandible only (Fig. 11, ∇) *C. australica* (Ulmer)

Pupae

1. Hook plates on segment 3 and 4 with 4–6 large teeth (Fig. 13) *C. monticola* Kimmins
 — Hook plates on segments 3 and 4 with 2 or 3 large teeth (Fig. 15) ... *C. australica* (Ulmer)

Adult females

1. Ninth sternite with 2 triangular sclerites (Fig. 17) *C. monticola* Kimmins
 — Ninth sternite with 2 sub-trapezoidal sclerites (Fig. 18) *C. australica* (Ulmer)

Adult males

1. Apices of parameres forming upturned hook on each side of penis (Mosely & Kimmins 1953, fig. 274; Neboiss 1986: 105) *C. australica* (Ulmer)
 — Apices of parameres triangular, not hooked (Mosely & Kimmins 1953, fig. 275; Neboiss 1986: 105) *C. monticola* Kimmins

posterior wings with forks 2, 3 and 5 present; discoidal cell present in both wings. Female abdomen terminates bluntly, segments 9 and 10 short.

Chimarra monticola Kimmins

Figs 1–9, 12, 13, 17

Chimarra monticola Kimmins in Mosely & Kimmins 1953: 402–403, fig. 275.

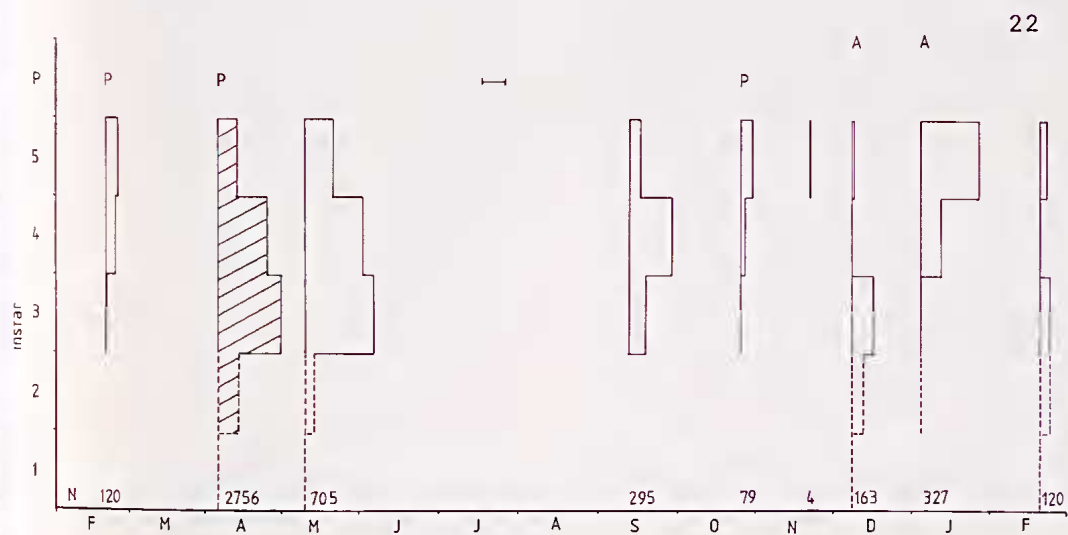
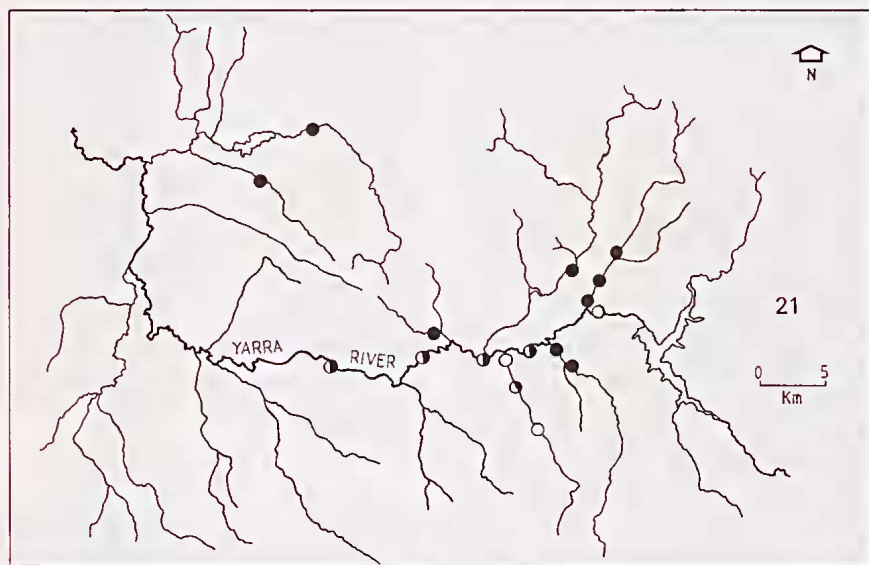
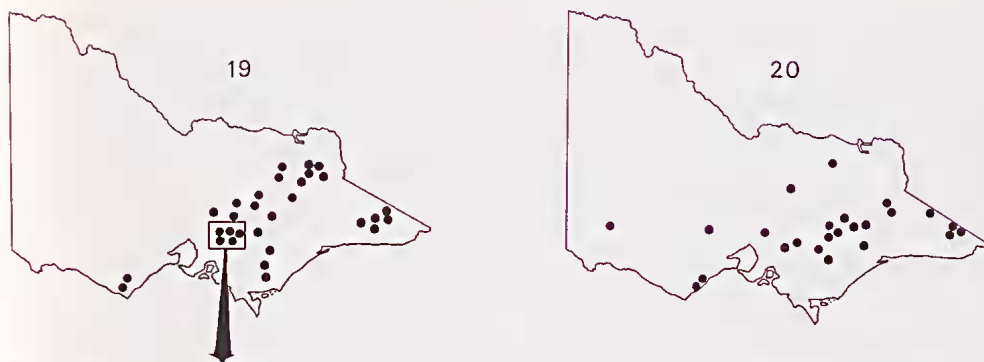
Diagnosis

Final instar larva. (Figs 1–9.) Length 8.3–11.7

mm ($\bar{x}$ = 10.1, n = 12). Head length about 1.5 × width (Fig. 6). Frontoclypeal notch V-shaped. Left margin of frontoclypeus projecting farther than right (Fig. 8). Both mandibles with small projection on inner margin mesially (Fig. 9).

Pupa. (Figs 12, 13.) Length 6.3–8.2 mm ($\bar{x}$ = 7.2 mm, n = 3). Mandibles with short, bifid sub-apical process (Fig. 12), slightly less conspicuous than in *C. australica*. Anterior hook plates on abdominal segment 3 usually with 4 teeth, segment 4 with 5 or 6 teeth (Fig. 13); generally with more teeth on each hook plate than on corresponding plate on *C. australica*.

Figs 19–22. 19, distribution of *Chimarra monticola* Kimmins in Victoria. 20, distribution of *Chimarra australica* (Ulmer) in Victoria. 21, distribution of *Chimarra* in the Yarra River system 50 km east of Melbourne: ● = *C. monticola* Kimmins recorded, ○ = *C. australica* (Ulmer) recorded, ◐ = both *Chimarra* species recorded. 22, seasonal abundance of instars of *Chimarra australica* (Ulmer) in the Yarra River, Peninsula Road, 1979–80: scale = 100 individuals for open histograms, 420 individuals for cross-hatched histogram; N = number of specimens collected on each sampling trip; P = prepupae and pupae recorded; A = adults collected; all *Chimarra* instars 1 and 2 have been included in the figure although a small proportion may have been *C. monticola*.



Female. (Fig. 17.) Black; wing venation as for male. Anterior wing length 5.6–8.6 mm ($\bar{x}$ = 7.2, n = 12). Female genitalia with eighth tergite and sternite entirely fused, apical margin fringed laterally with long setae. Ninth tergite arched; sternite with two triangular sclerites, their inner margins touching at base. Tenth segment with a pair of short, single-segmented cerci.

Chimarra australica (Ulmer)

Figs 10, 11, 14–16, 18

Chimarra australica Ulmer 1916: 3–5, figs 3–6.—
Mosely & Kimmins 1953: 399–402, fig. 274.

Diagnosis

Final instar larva. (Figs 10, 11.) Length 8.3–10.4 mm ($\bar{x}$ = 9.2 mm, n = 12). Head length about 1.5 × width. Frontoclypeal notch with flattened base (Fig. 10). Only left mandible with projection on mesal margin near middle (Fig. 11).

Pupa. (Figs 14–16.) Length 5.6–6.5 mm ($\bar{x}$ = 6.0, n = 2). Mandibles with bifid, subapical process (Fig. 14), slightly more conspicuous than in *C. monticola*. Anterior hook plates on abdominal segment 3 with 2 or 3 teeth, segment 4 with 3 or 4 teeth (Fig. 15); generally with fewer teeth on each hook plate than on corresponding plate of *C. monticola*.

Female. (Fig. 18.) Black; wing venation as for male. Anterior wing length 5.3–6.4 mm ($\bar{x}$ = 5.7 mm, n = 15). Female genitalia with eighth tergite and sternite entirely fused, apical margin fringed laterally with long setae. Ninth tergite arched; sternite with two sub-trapezoidal sclerites, their inner margins touching at base. Tenth segment with a pair of short, single-segmented cerci.

DISTRIBUTION IN VICTORIA

C. monticola is widely distributed in eastern Victoria, with records including high altitude streams on the Bogong High Plains and around Mount Buller. The only record from west of Melbourne is from the Otway Ranges (Fig. 19).

C. australica is also widespread in eastern Victoria but there are no records from high altitude streams, and the species is generally found in warmer streams than *C. monticola*. In western Victoria, *C. australica* has been recorded from the Wannon River, Lal Lal Falls and the Otway Ranges (Fig. 20).

Extensive collecting in the Yarra River system over several years has provided reasonably complete distributional data for that area (Fig. 21). *Chimarra* has not been recorded from first or second order streams, occurs in some third order streams, but appears to be more common in larger streams of order four or higher. *C. australica* has been collected from the mainstream of the Yarra River and Starvation Creek at several sites below a small weir. *C. monticola* is widely distributed in larger tributaries but has been recorded at four sites in the Yarra River mainstream where the two species overlap. *C. monticola* is, however, usually quite rare in mainstream samples where *C. australica* is always dominant.

BIOLOGY

Headwidths of larval instars of both species collected from the Yarra River at Peninsula Road during 1979–80, together with those of *C. monticola* collected from the O'Shannassy River in 1975–77 (from Dean & Cartwright 1987), are presented in Table 1. Instars 1 and 2 from the Yarra River could not be identified positively but, given the dominance of *C. australica* in later instars, most of the early instars probably also belonged to that species.

	INSTAR				
	1	2	3	4	5
O'Shannassy R.					
<i>C. monticola</i>	—	0.26–0.28	0.38–0.50	0.58–0.72	0.82–1.12
Yarra R.					
<i>C. monticola</i>	—	—	0.46–0.48	0.58–0.70	0.80–1.00
<i>C. australica</i>	—	—	0.34–0.46	0.48–0.66	0.70–0.92
<i>Chimarra</i> sp.	0.14	0.24–0.26	—	—	—

Table 1. Headwidth range (mm) of larval instars of *Chimarra monticola* Kimmins from the O'Shannassy River (Dean & Cartwright 1987) and *C. monticola* and *C. australica* (Ulmer) from the Yarra River 1979–80.

Based on instars 3–5 only, numbers of *C. monticola* in the Yarra River were typically low (less than 10% of the *Chimarra* individuals in each sample collected during 1979–80), although in samples collected in August and October of 1978, *C. monticola* comprised 29% and 25% of the total *Chimarra* numbers respectively.

Size distributions of instars of *C. australica* in the Yarra River samples during 1979–80 are illustrated in Fig. 22. The life cycle is difficult to interpret due to the absence of samples in some months, and the wide range of instars at certain times of the year. Instar 1 and 2 larvae were collected in April and May of 1979, and probably overwintered mainly as instars 3–5 and pupated during October–November. Instars 1 and 2 appeared in samples again in December and January, and probably grew rapidly to pupate in late summer–early autumn. Pupae were collected in February, April and October. With early instars present in autumn and summer, and pupae in late spring and late summer–autumn, the life cycle appears to be bivoltine, although poorly synchronized.

Capture nets of *C. australica* final instar larvae from the Yarra River had mesh openings of 1.1–1.2 μm by 2.1–14.6 μm . *C. monticola* in the O'Shannassy River had capture nets with mesh openings of 0.9–1.2 μm by 5.5–18.0 μm .

DISCUSSION

The two Victorian species of *Chimarra* can be distinguished by small but reliable characters: the shape of the anterior margin of the frontoclypeus and mandibles in final instar larvae; the number of teeth on the abdominal hook plates in pupae; and the shape of the distal sclerites attached to the ninth abdominal sternite of females. The shapes of both the frontoclypeal notch and the mesal margin of the mandibles have previously been used to distinguish larvae of *Chimarra* species in North America (Ross 1944) and South America (Marlier 1964). In pupae, there is some variability in the number of teeth on the hook plates of most segments, and this variability has also been reported by Lepneva (1970). This character should be used with some caution, although it has been found reliable in material examined in the present study.

The life cycle of *C. australica* in the Yarra River is poorly synchronized and apparently bivoltine. This contrasts with the life cycle of *C. monticola*, which was reported by Dean & Cartwright (1987) to be well synchronized and

univoltine. These differences can be explained by the higher water temperatures recorded in the Yarra River. Similar differences have been reported from the northern hemisphere, with bivoltinism being reported in species of *Chimarra* in Georgia (USA) by Cudney & Wallace (1980), in Virginia by Parker & Voshell (1982), in Quebec by Morin & Harper (1986), and in South Carolina by Smock (1988). Univoltinism has been documented in *C. atterrима* Hagen in Illinois by Ross (1944) and in Ontario by Williams & Hynes (1973).

Although *C. australica* was always dominant in the Yarra River during the study period, the proportion of *C. monticola* was higher in August and October of 1978 (25–30% of *Chimarra* individuals collected) than in 1979 (less than 10% of *Chimarra* in each sample). The higher proportion of *C. monticola* in 1978 may have been related to the much higher water flow in that year.

Nets of *Chimarra* species have been little studied. Wallace & Malas (1976) found that final instar larvae of *C. socia*? in North America produce nets with mesh openings ranging from 0.8 $\times$ 3 to 0.8 $\times$ 9 μm . In comparison with these sizes, the mesh openings of final instar larvae of the two Victorian species were slightly greater in width and extremely variable in length.

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